


Traffic Modeling and Interchange Analysis


Kris Milster, FHWA
H. Walker, FDOT



Goals

- FHWA and the Interstate
- Request for Access
 - Who does it
 - When does it happen
- Analysis Requirements
 - Planning
 - Design

2012 Design Training EXPO



FHWA and the Interstate

- To provide high levels of service in terms of safety and mobility
- Move freight and people efficiently and safely over long distances.
- It is FHWA's responsibility to protect both the structural and operational integrity of the Interstate System

2012 Design Training EXPO

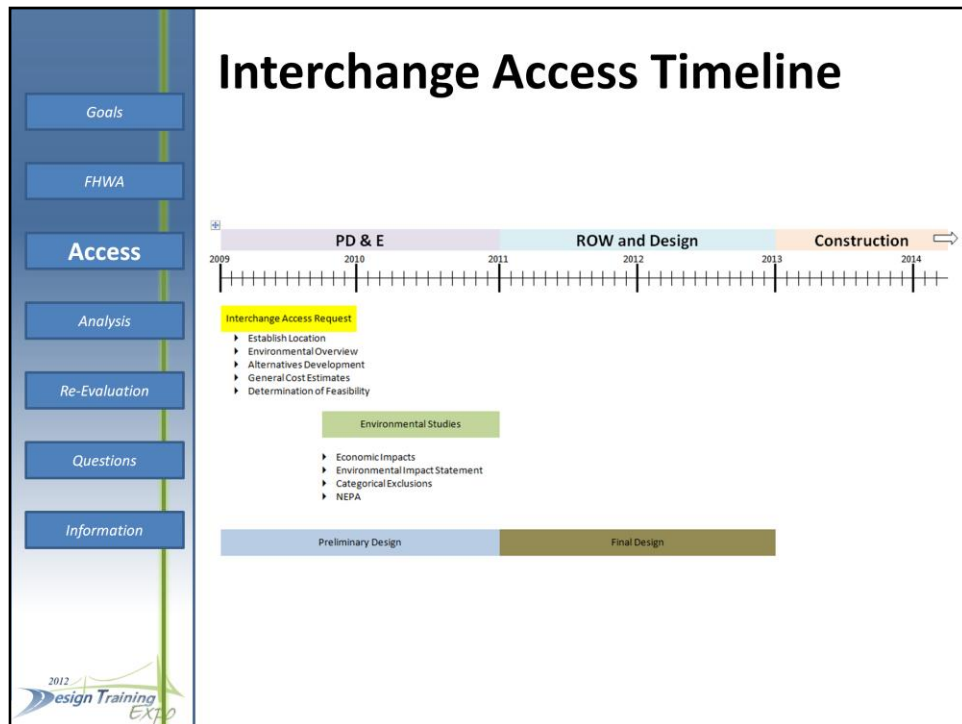
It is in the national interest to preserve and enhance the Interstate System to meet the needs of the 21st Century by assuring that it provides the highest level of service in terms of safety and mobility. Full control of access along the Interstate mainline and ramps, along with control-of-access on the local roadway network at interchanges, is critical to providing such service. Therefore, FHWA's decision to approve new or revised access points to the Interstate System should be supported by substantiated information justifying and documenting that decision.

Certainly the need to move both freight and people efficiently and safely long distances remains as its primary purposes. FHWA is charged with administering the program to design and construct the Interstate System. It is the FHWA's continuing responsibility to protect both the structural and operational integrity of the Interstate System.

It is in the national interest to preserve and enhance the Interstate System to meet the needs of the 21st Century by assuring that it provides the highest level of service in terms of safety and mobility. Full control of access along the Interstate mainline and ramps, along with control-of-access on the local roadway network at interchanges, is critical to providing such service. Therefore, FHWA's decision to approve new or revised access points to the Interstate System should be supported by substantiated information justifying and documenting that decision.

Although the State DOTs own and operate the Interstate System, FHWA is required to approve all new access or changes in access points pursuant to 23 U.S.C. 111.

The FHWA's interest is to ensure all new or revised access points:



Planning

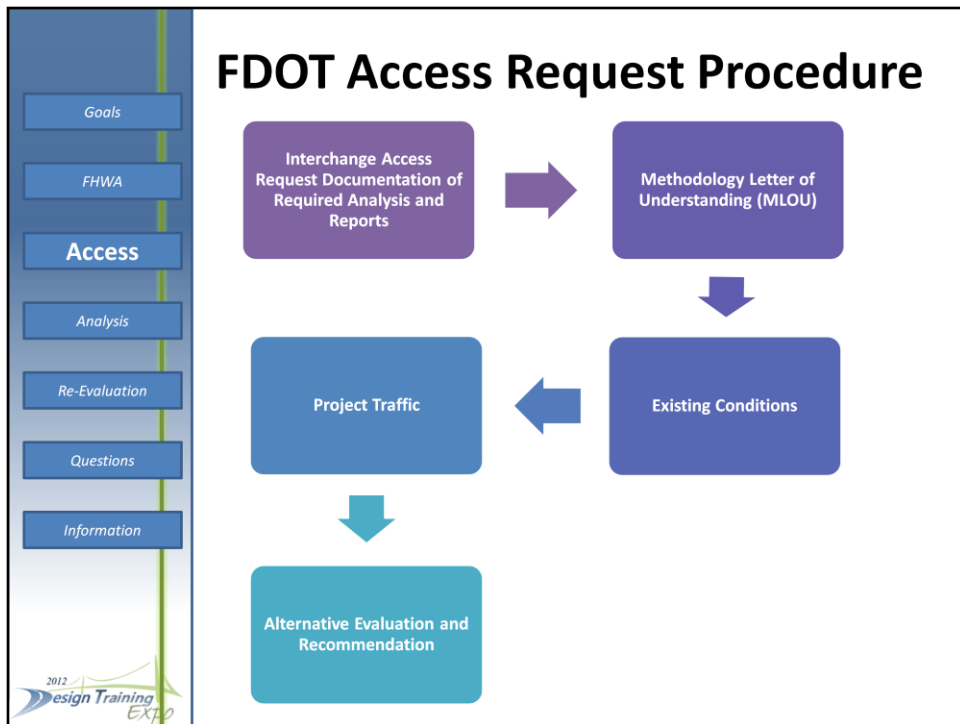
Highway planning to determine potential corridors and improvements is conducted well in advance of design and construction. Area population growth, future land use, jurisdictional responsibilities and other factors are used to determine the need, feasibility and general location of future highway improvements.

Study

The study stage establishes the location (alignment) and basic characteristics (number of lanes, type of traffic interchange, etc.) of a roadway. Accompanying this are environmental studies (noise, economic impacts, etc.), identification and evaluation of alternatives, general cost estimates, coordination with public and private partners and the determination of feasibility to move to the design phase.

Design

The design of a roadway involves several stages of detailed engineering, technical review, and approval by partnering and overseeing agencies at each stage. Project information is shared and discussed with the public at project milestones, and public input is considered in the evaluation of alternatives. The final design of the roadway is represented in plans and specifications that construction contractors use to prepare construction bids.



Interchange Access Request Documentation of Required Analysis and Reports

What is the need for the interchange?

How will you gather the data?

How do you propose to study the traffic impacts?

Methodology Letter of Understanding (MLOU)

How will you document the analysis

Existing Conditions

What are the existing traffic conditions within the influence area?

What transportation problems currently exist?

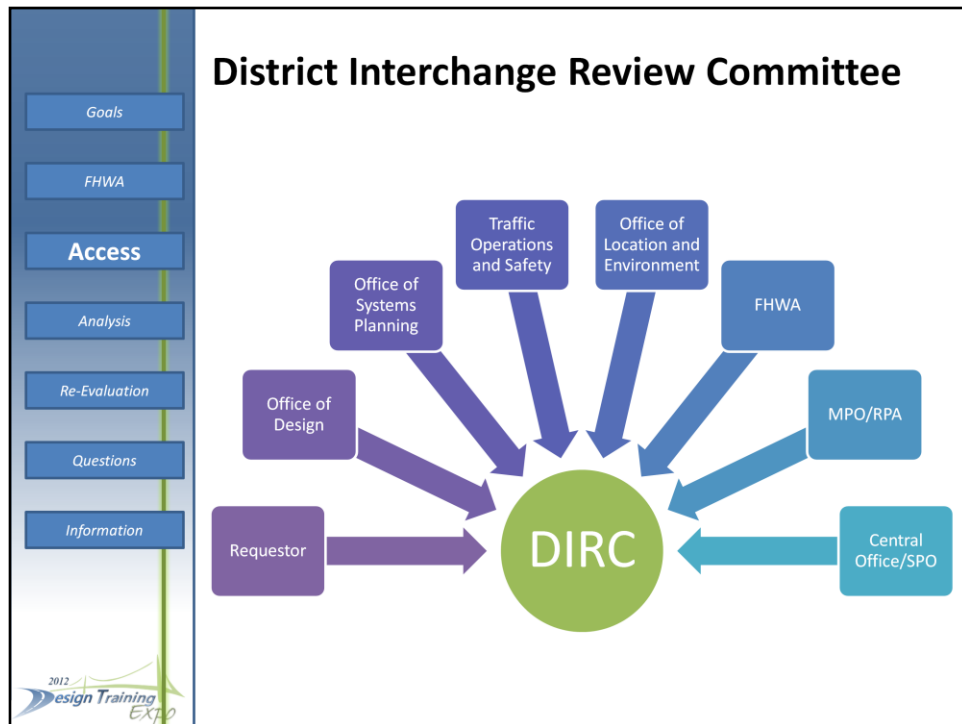
Project Traffic

What is the future traffic demand for the opening, interim and design years?

Alternative Evaluation and Recommendation

What are the impacts of different traffic solutions (including upgrading and existing transportation system)?

What is the recommended alternative?



Members of the DIRC typically include staff from:

- DOT District Office
- The Requesting Agency
- DOT Office of Design
- DOT Office of Systems Planning
- DOT Office of Traffic and Safety
- DOT Office of Location and Environment
- FHWA
- Metropolitan Planning Organization (MPO) /Regional Planning Agency (RPA)

The DIRCs role is to:

Review regional and state transportation plans to see if the request is consistent with the needs and solutions shown in those plans.

Develop purpose, need, and vision statements for the study. They should be consistent with the project environmental document.

Expedite the study steps (and, if needed, the IJR development and review process) through early communication and agreement.

Establish the agreed-upon study area (including baseline transportation improvements) and future travel demand forecasts for each of the alternatives being considered.

Provide guidance and support.

Evaluate data and identify possible alternatives for the proposal during the study and, if needed, for an IJR.


Contribute material for the report that documents the discussions and decisions.

Review results and determine whether an IJR is warranted.

Ensure the compatibility of data used in various studies.

Ensure integration of the Project Definition process, value engineering studies, public involvement efforts, environmental analyses, operational analyses, safety analyses, other analyses for the study (and, if needed, to prepare an IJR). This encourages the use of consistent data.

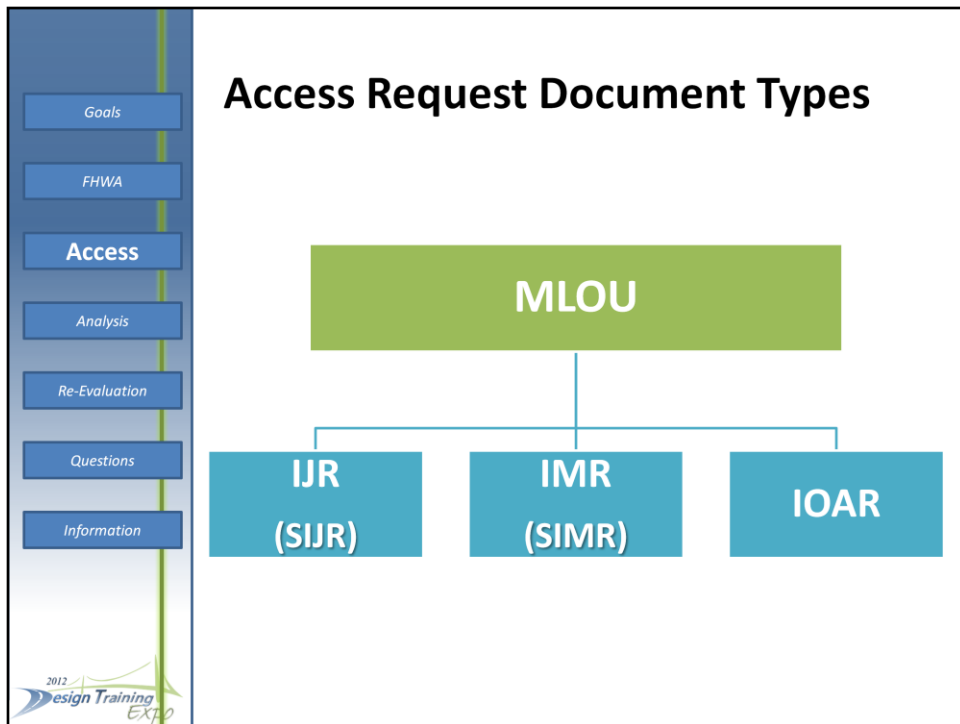
Address design elements. Status of known deviations must be noted in Policy Point 4. Deviations are discouraged on new accesses.



Interchange Access Request

- Accomplished During Planning/PD&E Phase
- Done Concurrently with:
 - Interstate – NEPA
 - Other Expressway - SEER
- Approval Authority:
 - Interstate Facilities –FHWA & FDOT
 - Other Expressways – FDOT & Local Expressway Authority
- Approval Condition:
 - Interstate – Location Concept Design Approval (LCDA)
 - Other Expressway – Acceptance of SEER

The purpose of an Interchange Access Request is to demonstrate the project is needed and is viable based on traffic, engineering, financial and other criteria. To ensure access decisions are properly administered, both FHWA and FDOT have adopted policies regarding interchange approvals.



There are four basic types of request documents for limited-access facilities with a brief description as follows:

MLOU

Methodology Letter of Understanding (MLOU)

A document providing agreements reached among the applicant, DIRC, SPO and, if applicable, FHWA during study design development of an Interchange Access Request.

IJR

Interchange Justification Report (IJR)

A document prepared for a proposed action intending to provide a new interchange to a Strategic Intermodal System limited access highway.

Requires the highest level of analysis and documentation to justify the need for and the operational impacts of the request.

IMR

Interchange Modification Report (IMR)

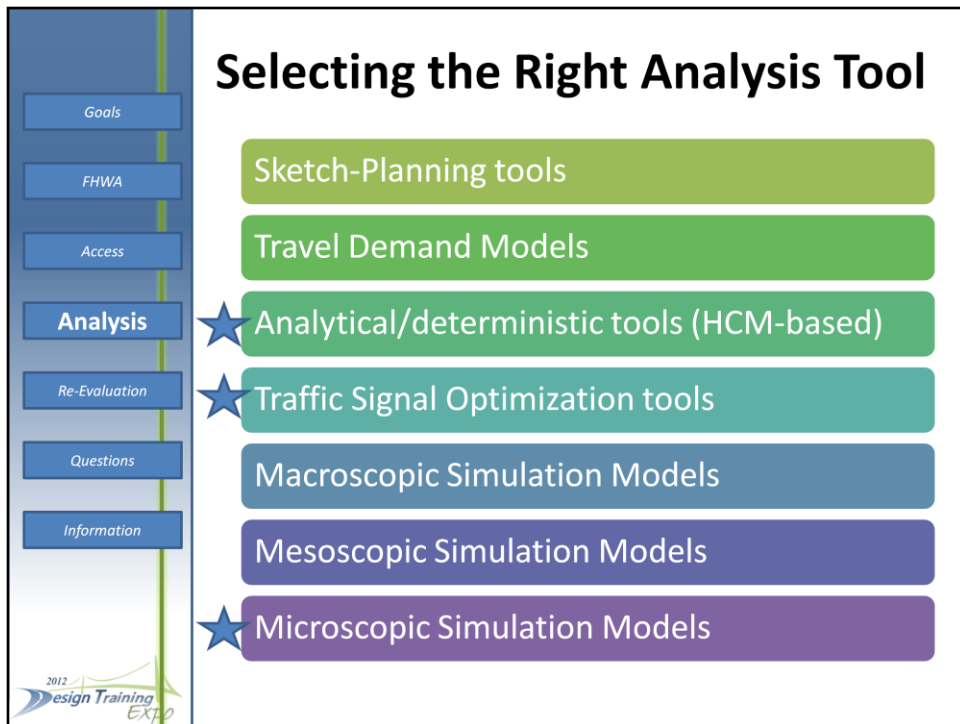
A document prepared for a proposed action intending to provide substantially modified access to an existing interchange on a SIS limited access highway

The extent and complexity of the proposed modification will determine the level of analysis and documentation required.

IOAR

Interchange Operational Analysis Report (IOAR)

A document prepared for proposed minor safety and/or operational improvements mostly within the existing right of way; not requiring an IMR.



There are many different types of analysis tools, and choosing what type can be quite daunting. The FHWA Traffic Analysis Toolbox Vol 2 categorizes all tools into 7 categories; however, in design only a few are more commonly used. Those are HCM-based, traffic signal optimization, and micro-scopic simulation with requiring travel demand model outputs.

The next few slides will discuss the most common conundrum: when to use HCM-based tools vs. simulation-based tools.

Goals

FHWA

Access

Analysis

Re-Evaluation

Questions

Information



HCM-based vs. Simulation

- HCM-based tools






As a designer, most projects will either need a HCM-based or simulation-type of analysis. While both tools work well, caution should be taken when deciding on which to use for an Interchange Analysis.

HCM-based tools are macroscopic and deterministic in nature, meaning that the same inputs will give the same outputs. This makes the QA/QC process much simpler than a simulation-based tool, as the outputs do not have statistical variance that can be disputed.

HCM-based tools should also only be used for moderate-to-light traffic conditions. When traffic appears to be congested, these methods fail as they do not accurately represent congested or over-saturated conditions. Furthermore, these types of analyses are only for isolated segments. In order for a designer to see

HCM-based tools give the average performance. Therefore, if traffic is very volatile in a short time, simulation-based tools should be used.

HCM-based tools give basic MoEs. While these are widely-used to show FDOT acceptability, there might be MoEs that FHWA would want to check in order to determine acceptability.

Goals

FHWA

Access

Analysis

Re-Evaluation

Questions

Information

2012 Design Training EXPO

HCM-based vs. Simulation

- Simulation tools







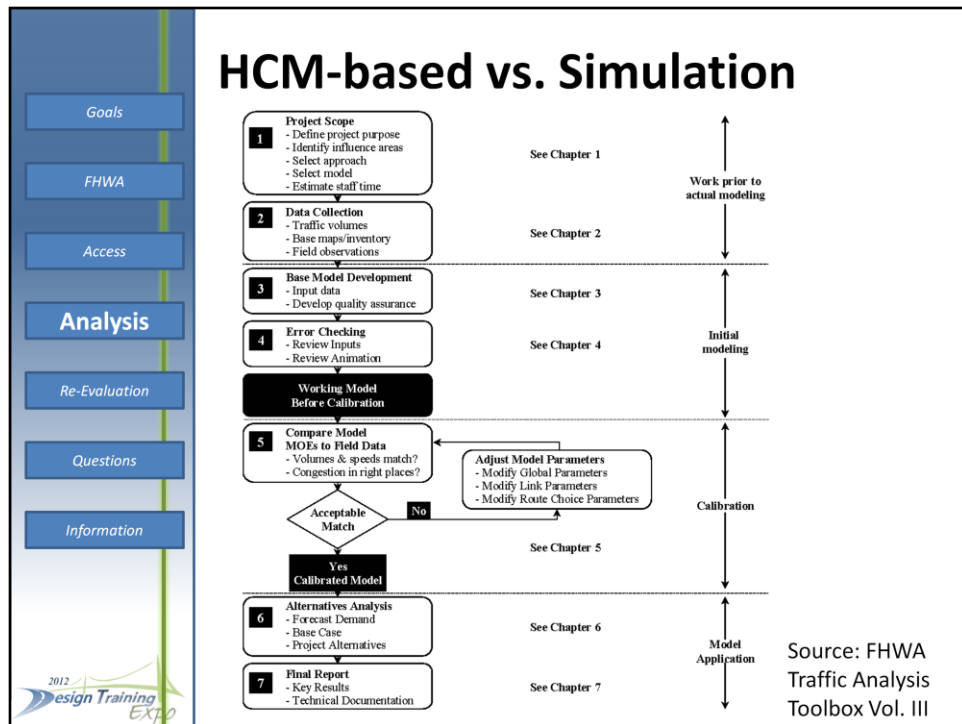
As a designer, most projects will either need a HCM-based or simulation-type of analysis. While both tools work well, caution should be taken when deciding on which to use for an Interchange Analysis.

Simulation-based tools are more complex and more expensive than HCM-based tools, but can show more detail. Therefore, there is a trade-off to these types of tools. For example, one can spend a lot of time, effort, and money and get a visually appealing and calibrated model, but if it is not warranted, then that effort could have been used elsewhere. However, one should not look at micro-simulation as a quick-fix, because a highly calibrated model is desired.

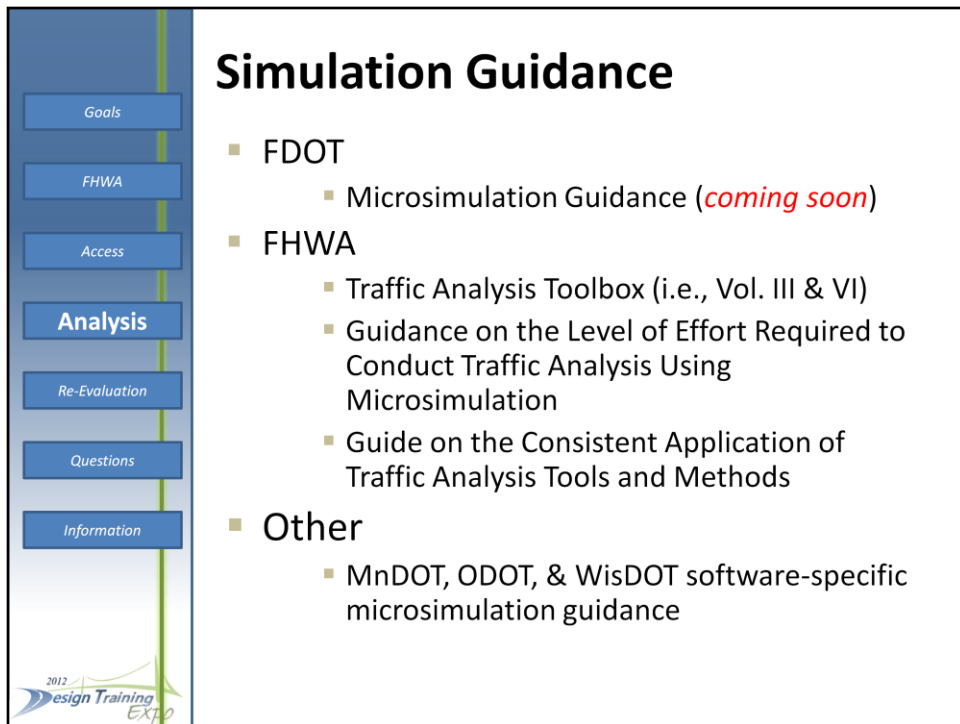
Simulation-based tools are stochastic. This means that random number seeds are used to generate vehicles on the roadway. The model is run a number of times to achieve a statistical significant value. While most outputs are averaged, this is not the most correct method as statistical variance can have a large impact on the results. The model needs to have a defined confidence interval that it adheres to.

Since simulation-based tools are more costly than HCM-based tools, they should be used primarily where HCM-based tools fall short. All shortcomings of HCM-based tools are contained within each chapter of the 2010 HCM and should be the point-of-reference when a decision has to be made. In most cases, microsimulation is used for corridors or for more congested locations.

Furthermore, microsimulation should be used when the impacts of freeways and arterials need to be considered. For example, if an off-ramp backs-up onto the mainline, this impact will need to be considered in the Interchange Access Approval



This slides shows the correct process when developing a microsimulation model. Keep in mind that the most scrutinized and possibly time-consuming steps are #2 – Data Collection & #5 – Calibration.




The slide features a vertical sidebar on the left with a blue background and white text. The sidebar contains a list of navigation items: 'Goals', 'FHWA', 'Access', 'Analysis' (highlighted in a darker blue), 'Re-Evaluation', 'Questions', and 'Information'. At the bottom of the sidebar is a logo for '2012 Design Training Expo'.

Simulation Guidance

- FDOT
 - Microsimulation Guidance (*coming soon*)
- FHWA
 - Traffic Analysis Toolbox (i.e., Vol. III & VI)
 - Guidance on the Level of Effort Required to Conduct Traffic Analysis Using Microsimulation
 - Guide on the Consistent Application of Traffic Analysis Tools and Methods
- Other
 - MnDOT, ODOT, & WisDOT software-specific microsimulation guidance

These are some of the most recent guidance documents available.



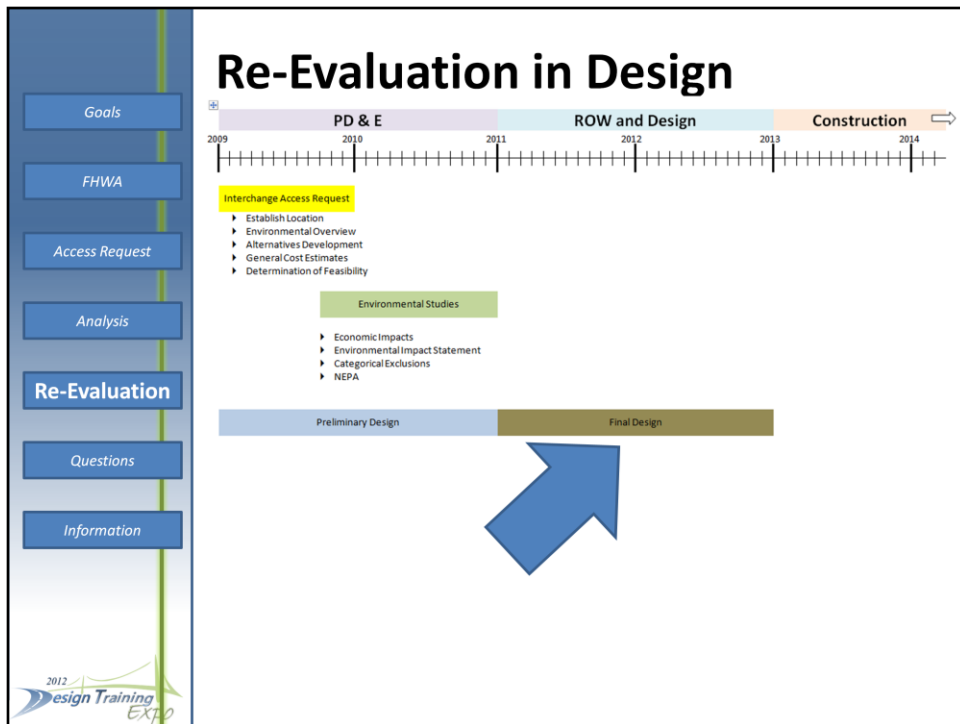
Previously Approved Access Request

- A Re-evaluation may be required if:
 - An accepted change in access has not progressed to construction within 8 years after receiving affirmative determination of the engineering and operational acceptability from FHWA
 - The design or operations of a project that was previously accepted is significantly changed (e.g., land use, traffic volumes, roadway configuration or design, environmental commitments)

The scope of the changes and the factors justifying the change will determine the level of analysis required.

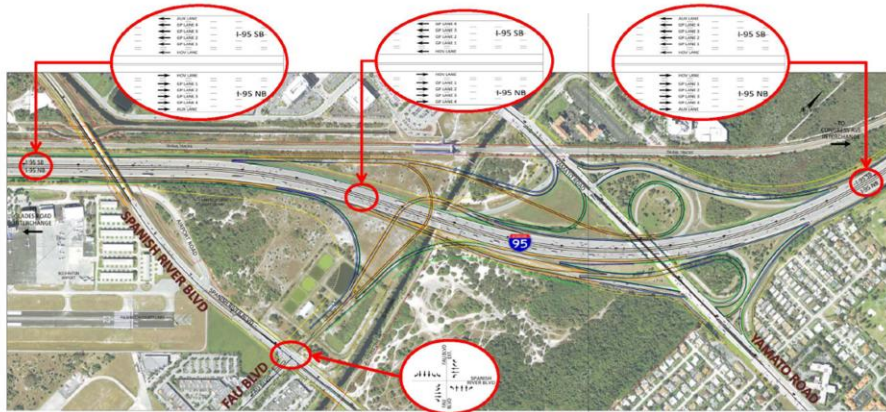
Examples of design features to be reassessed for major changes include, but are not limited to:

1. Changes in typical section
2. Shifts in roadway alignment,
3. Changes in right-of-way requirements,
4. Changing a bridge to a box culverts,
5. Changes in drainage requirements, and
6. Changes in traffic volumes that may affect traffic noise models.



Let's look at some scenarios of that may require re-evaluation during design

Scenario 1: FAU/Airport Interchange

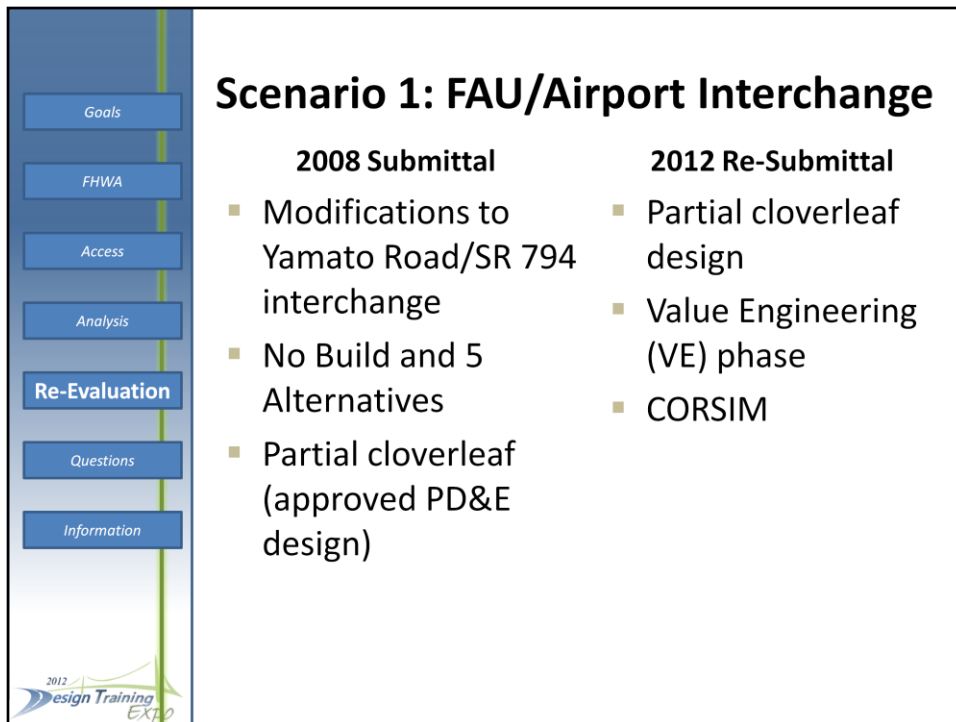


2008 Systems Interchange Justification Report
District IV



In 2008 District 4 submitted an Access Request

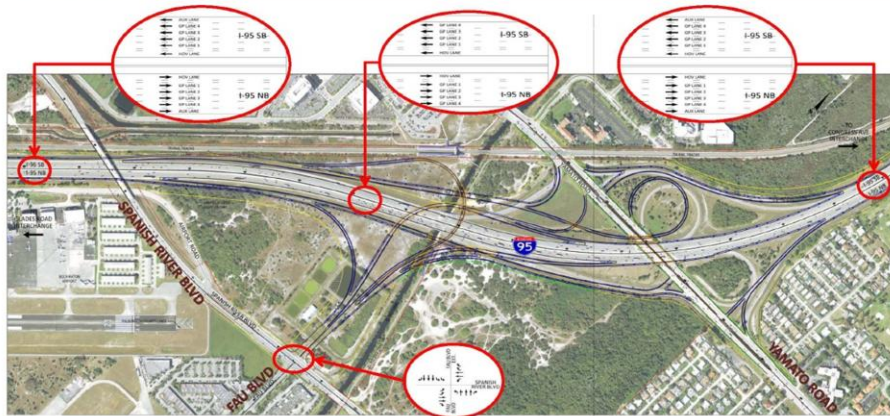
- A proposed 'Airport/FAU' interchange with Interstate I-95 (SR 9) near milepost 4.66 and proposed modifications to the Yamato Road/SR 794 (milepost 5.26) and Glades Road/SR 808 (milepost 2.80) interchanges.
- The report presented the steps involved in the development of future travel demand for a proposed new interchange between Spanish River Boulevard and Yamato Road, on I-95.



2012:

- The merits of one of the designs considered during the Value Engineering (VE) phase was re-examined.
- The *Project Value Engineering Final Report Part 1, Study Number 3 (session held in February 2007)* states that the modified diamond concept was conceptually dismissed due to potential operational issues. Notwithstanding, and due to the potential benefits that could be realized with this concept, including cost savings and better response to driver expectation, it was decided to reconsider and further analyze this concept.
- To completely assess the operations, the modified diamond was analyzed with CORSIM software.
- The CORSIM results yielded excellent levels of service (LOS 'A' and 'B') for the four (4) signalized ramp termini. As part of the analysis, the four signals were simulated to be controlled by two controllers – one for the two signals on the east side of the interchange and one for the signals on the west side. However, due to concerns from the Traffic Operations Office regarding the close proximity of the western-most signal to the CSX railroad tracks and the potential safety issues associated with this condition, the modified diamond concept was dismissed.
- For the purposes of the CORSIM analysis, the study area was delimited following the CORSIM results documented in the original SIJR and consistently with the previously approved SIJR CORSIM files.

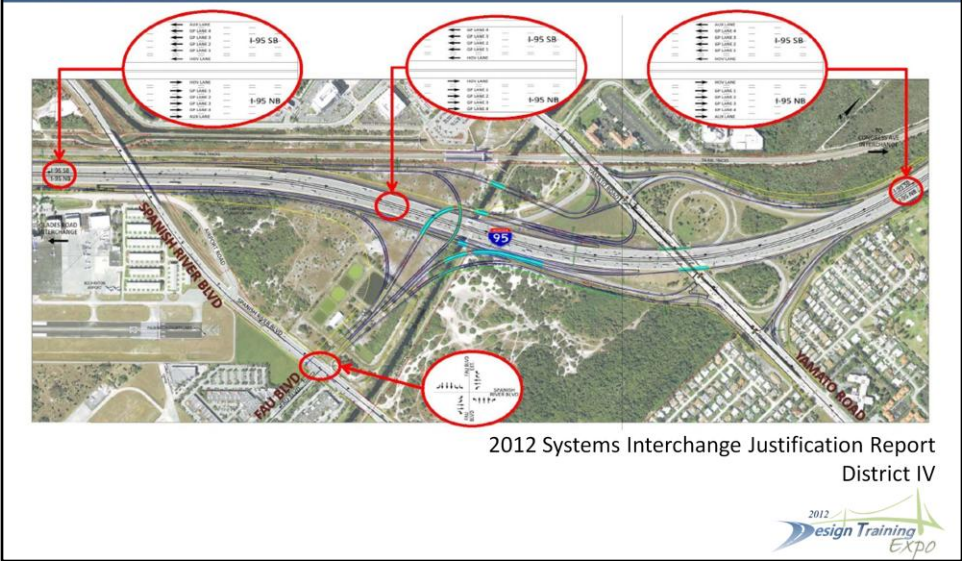
Option A: Modified Diamond w/WB to SB Loop



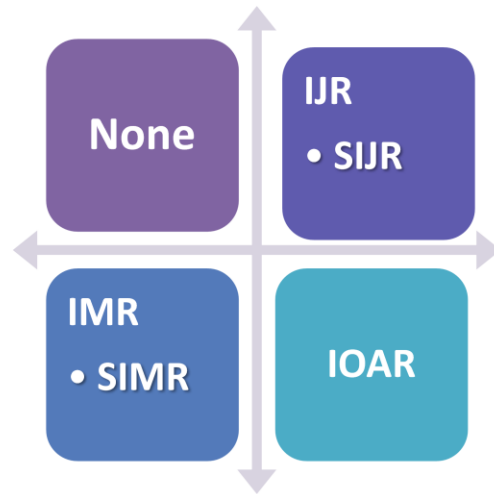
2012 Systems Interchange Justification Report
District IV



Option B:
Modified Diamond/Diamond Hybrid

2012 Systems Interchange Justification Report
District IV

Scenario 1: Type of Re-Submittal?



Goals

FHWA

Access

Analysis

Re-Evaluation


Questions

Information

2012
Design Training
EXPO

Scenario 2

- New Interchange
- Interchange Justification Request (IJR)



*Interstate 10 at State Road 23
District II*

There is a six-lane project going through this section of the interstate:

- Hypothetically, during design it was discovered that the project will impact the eastbound off-ramp to SR 23, requiring the exit to be shifted 750 feet east.
- Options:
 - Analysis Requirements?
 - Documentation Requirements?

Goals

FHWA

Access

Analysis

Re-Evaluation

Questions

Information

2012
Design Training
EXPO

Any Questions?



There is a six-lane project going through this section of the interstate:

- Hypothetically, during design it was discovered that the project will impact the eastbound off-ramp to SR 23, requiring the exit to be shifted 750 feet east.
- Options:
 - Analysis Requirements?
 - Documentation Requirements?

Goals

FHWA

Access

Analysis

Re-Evaluation

Questions

Information



Contacts

Kris Milster
Federal Highway Administration
ITS/Traffic Operations Specialist
(850) 553-2246
kris.milster@dot.gov

H. Walker, P.E.
Systems Planning Office
Interchange Access Coordinator
(850) 414-4926
holly.walker@dot.state.fl.us